AOE 3134 Problem Sheet 9

The code DYNSTAB1.FOR is a FORTRAN code that determines the system (A) matrix, its characteristic values (eigenvalues) and if you wish, its eigenvectors. It reads data from a data file called NAVION.DAT and outputs the results in a file called STAB8.DAT. (It also produces a file called STAB6.DAT). This code is available in an executable format DYNSTABLE.EXE If you wan to see what the code looks like, you can look at DYNSTABLE.FOR which is called a source file. However, you can't run a source file. A source file must be compiled into an object file and then linked to produce an *.EXE file that can be executed. That's what's provided on the web site <<u>www.aoe.vt.edu/~lutze/AOE3134</u>> There are four files that are stored in a .zip format. When unzipped you should have the fortran file, the exec file, the NAVION.DAT file, and the STAB8.DAT file (example output).

You can edit the file NAVION.DAT to change the data to fit your aircraft. It must retain exactly the same number of variables as there are currently in any given line, in the same order. I would suggest making a copy of it, and changing its name for backup purposes. Likewise for the STAB8.DAT file. Then change the data in the remaining NAVION.DAT file to meet your needs. Problem:

1) For the Navion aircraft, whose data is supplied in the given data file, verify that the code is running correctly and produces the same results as the original output file. Locate and plot the location of the longitudinal and lateral-directional characteristic values on two separate plots, one a longitudinal plot, and the other a lateral directional plot.

2) Determine how the roots of the longitudinal diagram change with increasing (making less negative or making more positive) the stability derivative $C_{m_{\alpha}}$. Sketch the locus of roots as the parameter is changed.

3) Put $C_{m_{\alpha}}$ back to its original value, and change $C_{m_{q}}$ in the same manner. Sketch the locus of roots as this parameter is changed.

4) The two complex conjugate pairs of roots correspond to the short period and phugoid modes. Discuss which mode is affected the most by changing $C_{m_{\alpha}}$ and by changing $C_{m_{q}}$. Explain your observations!

5) Determine the effect of changing $C_{n_{\beta}}$ on the lateral-directional roots. Make a sketch of the locus of roots as this parameter is varies from positive to negative.

6) Restore $C_{n_{\beta}}$ to its original value, and vary $C_{l_{\beta}}$ from its negative value to a positive value and sketch the locus of roots for this change.